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A Study on Delay Analysis and Its Financial Implications in Construction Projects

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Abstract

The construction industry plays a very important role to contribute in national economic development. however, project delays remain a consistent challenge affecting overall project performance and profitability. This research study focuses on delay analysis in construction projects and examines its related financial implications. The study identifies major causes of delays and classifies them into excusable, non-excusable, compensable, and non-compensable categories based on contractual perspectives. A mixed-method research approach is adopted, incorporating an extensive literature review, case study evaluation, and questionnaire surveys conducted among key the construction professionals. The analysis highlights that delay commonly arise due to design modifications, unfavorable site conditions, improper planning, and inefficient resource management, which subsequently lead to financial losses. These losses include increased overrun cost, imposition of liquidated damages, increase in material costs, and loss of possible revenue opportunities for project owners. The project study further examines the role of contractual provisions, Critical Path Method (CPM), scheduling, and forensic delay analysis techniques in resolving delay related claims. The findings indicate that effective risk management practices and the adoption of digital project monitoring tools can significantly minimize delay induced financial impacts, with potential cost reductions ranging between 15% and 20%. This research study aims to identify the main causes of delay analysis and its financial implications in construction project. Due to limited time and availability of information, research is conducted through literature reviews and questionnaire surveys. The findings of this research work will help the contractors and subcontractors in Karnataka state to mitigate or control the irregularities in the future construction works.

Keywords: Construction Management, Delay Analysis, Financial Implications, Schedule Overruns, Liquidated Damages, Critical Path Method, Risk Management, Cost Overruns, Forensic Delay Analysis, Contract Administration.

Introduction

Construction projects are complex in nature due to the involvement of multiple stakeholders, detailed requirements of design and drawing, limited availability of resources, and constantly changing technical, financial, and regulatory conditions. Because of these complexities, delays are frequently experience during the execution of construction projects and in many cases, become unavoidable. As a result, delay analysis has gained major importance in construction project management. Delay analysis helps in identifying, measuring, and evaluating delays and their impacts on project duration, cost, and productivity. It provides a structured method to determine the causes of delays, allocate responsibility among parties, and assess their financial consequences, which supports effective decision making and dispute resolution. The construction industry plays an important role in national development by contributing substantially to economic growth and employment generation. It acts as a major driver of infrastructure development and requires extensive material, financial, and managerial resources compared to many other industries. Despite its importance, the industry continues to face serious challenges related to time overruns and cost overruns, particularly in Indian construction projects. Cost overrun refers to the situation where actual project expenditure exceeds the originally approved budget due to inaccurate estimates, unfavorable site conditions, scope changes, or inefficient project management practices. Since delays and cost overruns often occur simultaneously, there is a growing need for detailed research on delay analysis techniques to reduce time overruns and control financial losses in future construction projects.

Definition of Delay in Construction

A construction project delay can be defined as any event, condition, or action that extends the completion of a project beyond the planned or by contract agreed schedule. Delays may affect individual activities, specific milestones, or the overall project duration. Depending on their nature and cause, delays may result only in time extensions or may also lead to cost overruns due to increased overhead costs, idle resources, reduced productivity, penalties, and claims. Construction delays are generally classified based on responsibility and contractual entitlement, as discussed below.

1. **Excusable delay:** Excusable delays arise due to unavoidable circumstances that are beyond the control of the contractor. These delays allow the contractor to an extension of time without the imposition of penalties; however, they usually do not allow financial compensation. Common examples include adverse weather conditions, changes in design or scope, unforeseen site conditions, and labor strikes. Such delays are often covered under unexpected event clauses, where external events prevent timely completion of the project.
2. **Non-Excusable Delays:** Non-excusable delays occur due to factors that are within the contractor's control. In such cases, the contractor is not allowed to an extension of time or any financial compensation, and the owner may recover damages as per the contract provisions. Typical causes include inadequate manpower, poor site supervision, financial difficulties faced by the contractor, delays caused by subcontractors, failure to follow the approved work schedule, lack of skilled labor, and non-compliance with owner specifications. If specified in the contract, non-excusable delays may result in the imposition of liquidated damages on the contractor.
3. **Compensable Delays:** Compensable delays occur due to the actions or lack of action by the client by the client or owner. In such cases, the contractor gets extra time and financial compensation for the additional costs. These delays commonly occur due to changes in the scope of work, late approval of drawings, delayed site handover, delay in material supply or information by the client, and Difference between actual site conditions and specified site conditions. Compensation is given as per the contract terms.
4. **Concurrent Delays:** Concurrent delays happen when two or more delays occur at the same time and affect the project schedule. In such cases, determining responsibility becomes complex. For example,

if site access is refused by the owner while adverse weather conditions occur at the same time, the contractor may be entitled only to a time extension but not full compensation. When two delays happen at the same time and one is compensable while the other is non-compensable, the contractor is usually given extra time, as per the contract.

Effects of Delays

Construction delays can have several direct and indirect impacts on project performance, including:

- Time overruns
- Cost overruns
- Disputes between project stakeholders
- Arbitration proceedings
- Litigation
- Total abandonment of projects
- Poor coordination within the site and with subcontractors
- Reduced worker morale and fatigue
- Increased errors due to overwork
- Loss of opportunities for undertaking other projects
- Indirect effects leading to additional delays and cost escalation

Construction Delays and Reasons for Delays

Construction delays refer to interruptions or extensions in project schedules that prevent timely project completion. Delays can occur due to a wide range of factors such as unfavorable weather conditions, shortages of materials, labor issues, financial constraints, and disputes among stakeholders. While many delays result from uncontrollable external factors, they often lead to serious financial and legal consequences when project deadlines and budgets are not achieved. Delays are not always caused by contractors alone. In many cases, clients or owners initiate decisions or changes that significantly affect project schedules. Common examples of client-related delays include:

- Late design changes requiring additional work or rework
- Delays in approving drawings, documents, or variations
- Contractual disputes leading to suspension of work
- Delays in payments to contractors and suppliers
- Inadequate or delayed funding arrangements

Importance of Delay Analysis

Delay analysis is a critical component of construction project management because it:

- Identifies the sources and impacts of delays
- Determines responsibility among project stakeholders
- Supports preparation and resolution of delay claims
- Ensures transparency and fairness in contract administration
- Protects project profitability by identifying avoidable losses
- Improves planning, scheduling, and risk management practices
- Assists in decision-making related to time extensions and compensation

Without proper delay analysis, construction projects are more likely to face disputes, cost overruns, quality issues, and loss of trust among stakeholders. Delay analysis is a method used to find, measure, and decide who is responsible for delays in a project. The main aim is to understand how delays affect the project schedule and to decide whether extra time or money should be given. Proper delay analysis helps in identifying the main causes of delays, separating excusable and non-excusable delays, supporting claims with facts, and improving planning for future projects.

Objectives of Delay Analysis

The main objectives of delay analysis in construction projects include:

- Identifying the causes of delays, whether technical, managerial, financial, or external
- Quantifying the extent of delays in terms of time and milestone impacts
- Determining responsibility for delays among owners, contractors, or third parties
- Evaluating financial implications such as cost overruns, loss of productivity, and increased overheads
- Assessing the impact of delays on the critical path of the project
- Supporting contractual claims for extensions of time or financial compensation
- Preventing future delays by applying lessons learned and improved management strategies

Literature Review

Tosniwal and Vanakudari (2018) The research of the project studied delay analysis and its effects in the construction industry. Their research highlights that delay mainly occur due to poor planning, improper scheduling, shortage of skilled labor, delays in material supply, and weak coordination among project participants. The study points out that construction delays lead to time overruns, increased project costs, reduced productivity, and frequent disputes between contractors and owners. The authors emphasize that proper delay analysis is necessary to identify responsibilities and to reduce conflicts related to delay claims.

Rauzana (2016) The study analyzed that causes of delays and time performance in construction projects. The study identifies factors such as design changes, financial issues, delayed decisions by clients, poor site management, and unforeseen site conditions as major reasons for project delays. The findings show that these delays negatively affect project schedules and contribute to cost overruns and disputes. The author concludes that effective planning, realistic scheduling, and better coordination among stakeholders are essential for improving time performance in construction projects.

Salha, Sankar et al. (2022) identified the factors affecting cost and schedule overruns in construction projects, including delays in quality assurance, accidents, and conflicts among parties. The author stated that Construction projects in India face cost and schedule overruns and hence the study aims to identify factors causing delays and cost overruns. Delay in quality assurance and Conflicts among parties were identified to be the crucial factors through questionnaire survey.

Sindhu Vaardini U et al. (2015) identified that Time overruns are the crucial problems faced in the construction industry. Since delays are considered to be a serious problem in the construction industry this study examines the factors that cause delay in construction projects. Based upon the relative importance index method the most critical factors ranked were Inaccurate construction planning, Owners delay in freeing the contractor financial payment, Improper scheduling resulting in poor judgment of time and resources, Shortage of construction materials at site and Contractors financial difficulty.

Methodology

A literature review was first carried out to identify the factors causing delays and their financial impacts in construction projects. This helped in conducting a survey to determine the main causes of delays in the construction industry in Bharat. To achieve these objectives, a research methodology was followed. The key stages involved in carrying out this study are explained below.

- Identifying the problem
- Specifying research objectives
- Specifying research scope
- Data collection
- Literature research
- Questionnaire
- Interaction with contractors
- Collection of feedback / inputs from contractors
- Data analysis
- Results
- Conclusion and Recommendation

Designing and collecting data through a questionnaire survey

A questionnaire containing 41 questions was prepared based on the factors identified from the literature review related to construction delays, their financial impacts, and methods to reduce delays. The questionnaire survey was used to understand the views of contractors on the importance of different causes and effects of construction delays. This survey served as the primary source of data for the study. A digital survey method was selected due to the limited time available for the research. Information obtained from the literature review was used to design the questionnaire. The survey was conducted using Google Forms and was shared with selected contractors through email and WhatsApp to save time and cost. In some cases, face-to-face interviews were also carried out where contractors were willing to provide detailed responses and feedback.

Response types

The structured questionnaires are further classified based on the type of responses such as follows

- Type 1 – Frequency based responses
  Each statement was evaluated using a frequency-based response scale consisting of (Always - 3, Occasionally - 2, Never - 1).
- Type 2 –Severity-based categorical responses
  Each statement was evaluated using a severity-based categorical scale comprising four levels: Minimal, Moderate, Significant, and Critical.
- Type 3 – Qualitative rating scale
  Each statement was assessed using qualitative rating options, namely Poor, Fair, Good, and Excellent.
- Type 4 – Experienced based or open-ended responses
  Each statement in these questions was evaluated using contractors experienced based responses.

Table 1: Frequency based questions asked to Contractor

Q. No	Questions
1	How frequently do delays occur in your projects?
2	How often do external factors (e.g., weather, government regulations) contribute to delays?
3	Does equipment breakdown or unavailability lead to measurable time loss?
4	Are project delays formally documented and analysed at each stage?
5	How often do excusable delays (beyond contractor's control) occur?
6	How often do non - excusable (within contractors' control) occur
7	How frequently do delays lead to disputes or arbitration?
8	How frequently do concurrent delays (multiple overlapping causes) occur?

Table 2: Severity based questions asked to Contractor

Q. No	Questions
9	To what extent the labour shortages affect the project timelines?
10	How significant are material shortages and supply chain issues in causing delays?

Table 3: Frequency based questions asked to Contractor

Q. No	Questions
11	How often do design changes or scope variations occur during execution?
12	How effectively are communication and coordination maintained between project stakeholders?

Table 4: Experienced based or open-ended responding questions asked to Contractor

Q. No	Question
13	Was there any project cost escalation?
14	What is the source of project funding (e.g., government, private, PPP, loan)?
15	What procurement method was adopted (e.g., Design–Bid–Build, EPC, Turnkey)?
16	What type of contract you prefer the most? (e.g., Lump Sum, Unit Rate, Cost Plus)?
17	What are the main causes of delays from the client side (e.g., late payments, design changes)?
18	What are the main causes of delays from the contractor side (e.g., resource shortage, poor planning)?
19	What is the consultant-related causes of delay (e.g., delayed approvals, design errors)?
20	What method(s) are used to identify project delays (e.g., schedule tracking, progress reports)?
21	Which delay analysis techniques do you use (e.g., As-Planned vs. As-Built, Time Impact Analysis)
22	How frequently are project schedules updated to reflect actual progress?
23	What tools or software are used for delay analysis (e.g., Primavera P6, MS Project)?
24	How accurate and reliable are the baseline schedules used for analysis?
25	How is float ownership (total or free float) determined between parties?

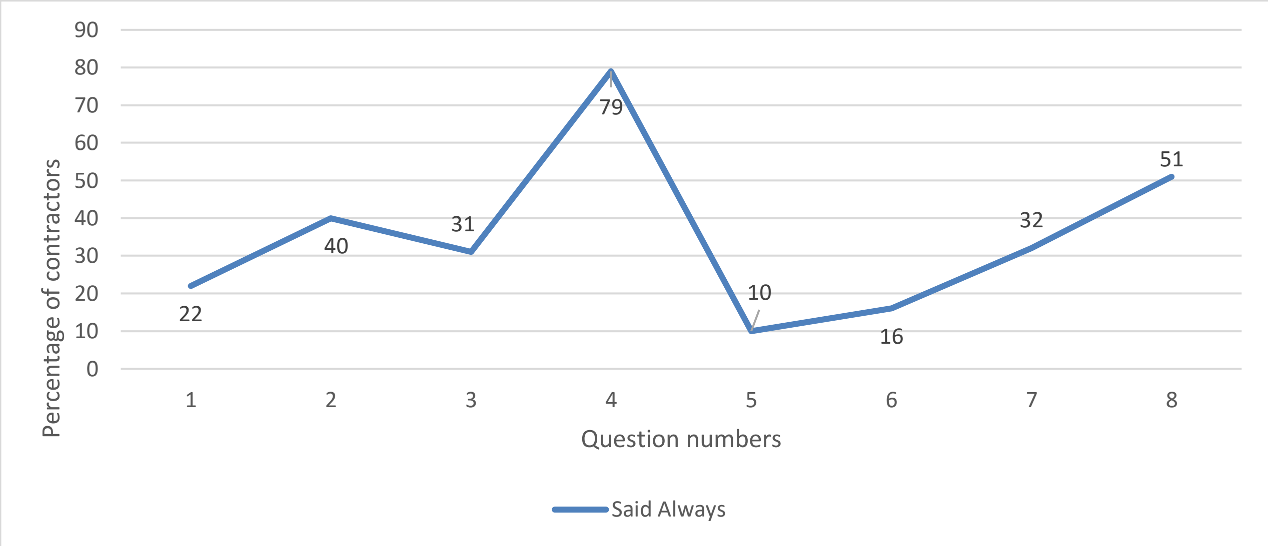
26	Who is responsible for performing delay analysis — contractor, consultant, or third party?
27	What percentage of delays are compensable (entitle the contractor to time and cost claims)?
28	What percentage of delays are non-compensable (Extension of Time only)?
29	How are concurrent delays analysed or apportioned in your projects?
30	How do delays impact the overall project cost?
31	What percentage increase in total cost is typically observed due to delays?
32	How do delays affect cash flow and payment schedules?
33	What percentage of project cost was claimed for EOT?
34	How are liquidated damages or penalties applied for delayed completion?
35	What is the response time taken by the clients for delays claimed by the contractors
36	What percentage of profit margin is generally reduced due to delay-related costs
37	Are risk assessments carried out at the planning stage to anticipate potential delays?
38	What preventive measures are taken to minimize delay risks?
39	How effective are current project monitoring and reporting systems in controlling delays?
40	What lessons have been learned from previous delayed projects to improve future performance?
41	What recommendations would you make to minimize delay and financial losses in future Projects.

Result and analysis

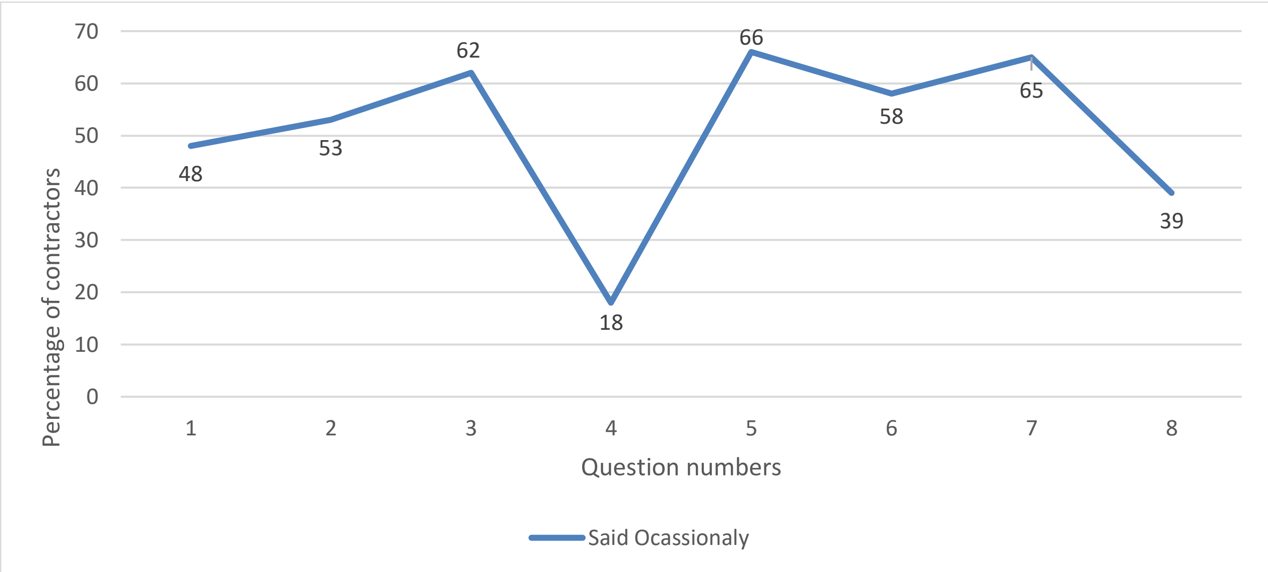
Table 5: Frequency based questions asked to Contractor

Q. No	% of contractors Said Always	% of contractors Said Occasionally	% of contractors Said Never
1	22	48	30
2	40	53	7
3	31	62	7
4	79	18	3
5	10	66	24
6	16	58	26
7	32	65	3
8	51	39	2

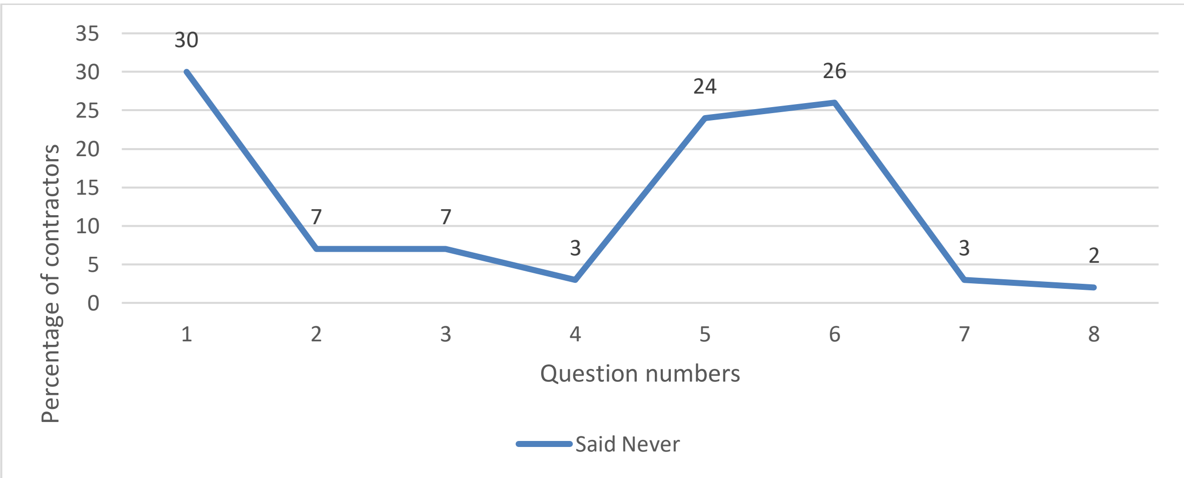
Graph 1: Representation of percentage of Contractors said always for the questionnaires



Graph 2: Representation of percentage of Contractors said always for the questionnaires



Graph 3: Representation of percentage of Contractors said always for the questionnaires



Graph 4: Representation of percentage of Contractors said always, occasionally and never for the questionnaires

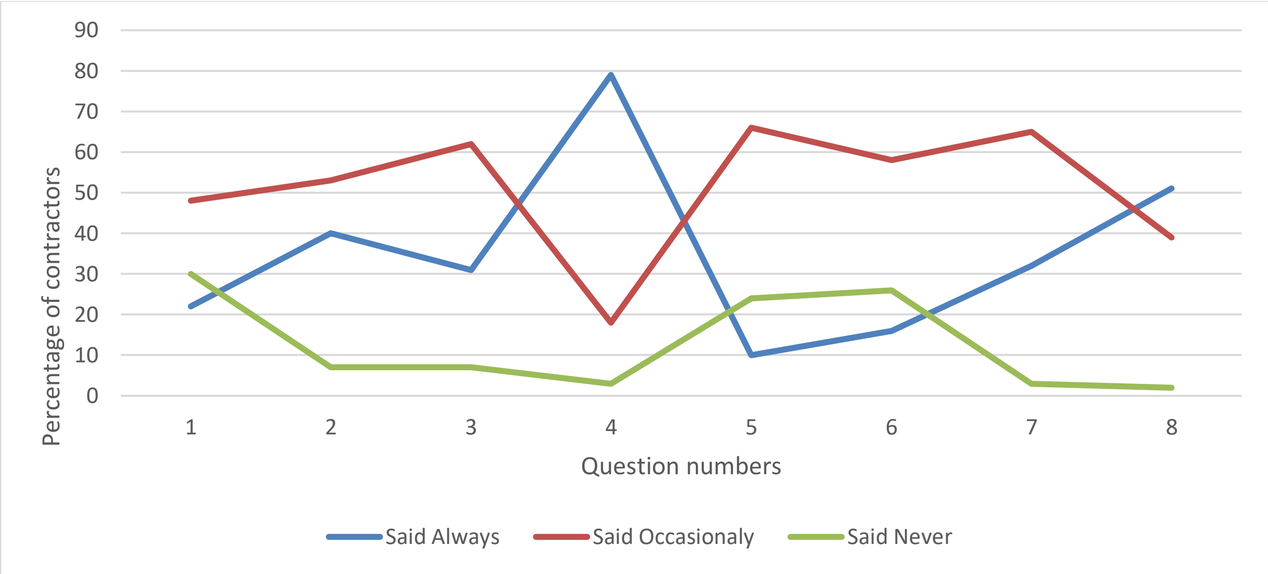


Table 6: Severity based questions asked to Contractor

Q. No	% of contractors Minimal	% of contractors Moderate	% of contractors Significant	% of contractors Critical
9	34	37	26	3
10	34	37	24	5

Graph 5: Representation of percentage of Contractors said Minimal, Moderate, Significate and Critical for the questionnaires

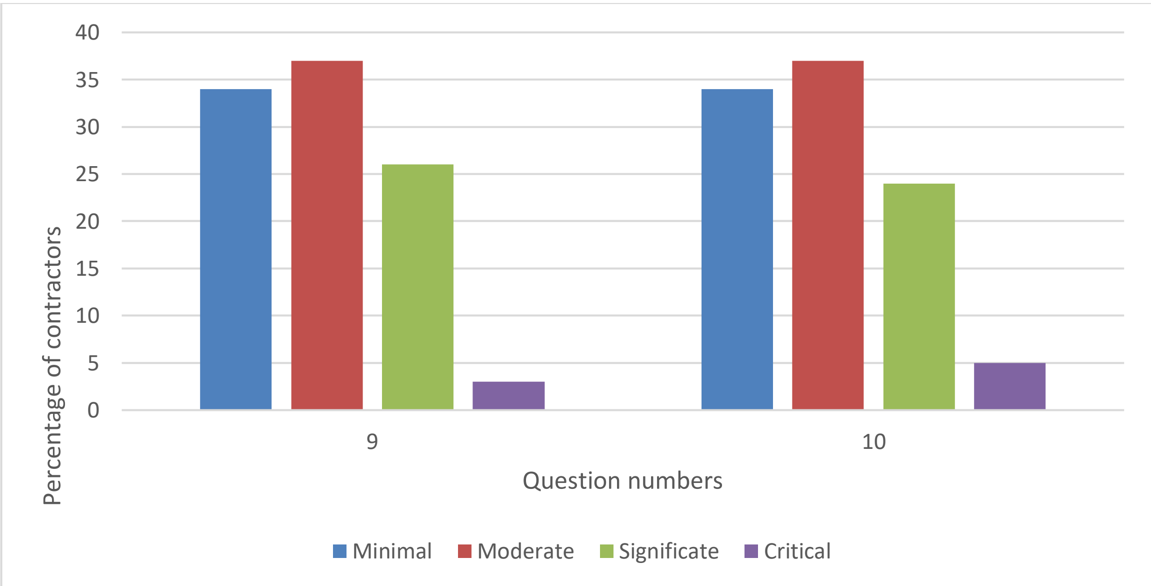
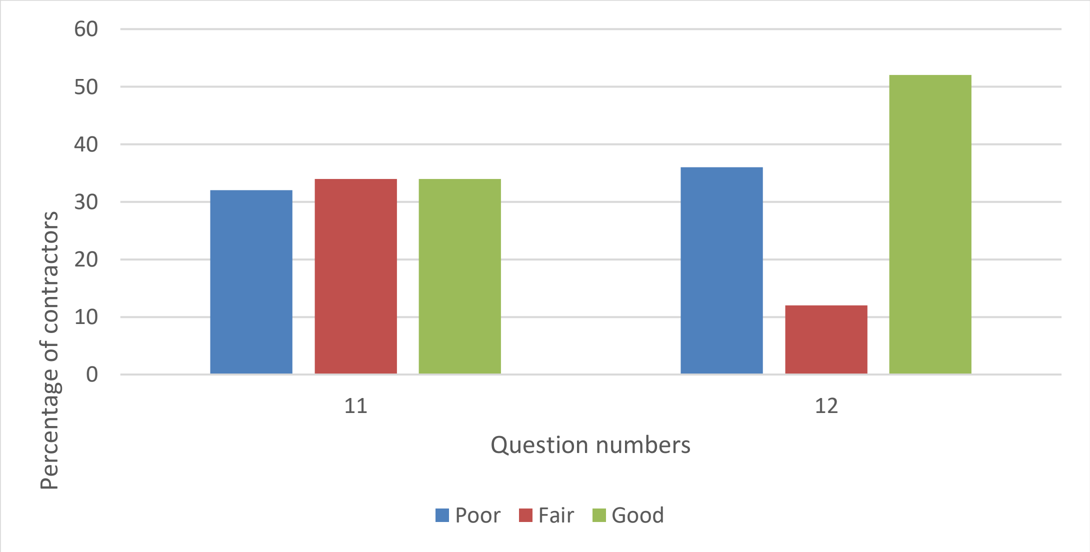


Table 7: Frequency based questions asked to Contractor

Q. No	% of contractors said Poor	% of contractors said Fair	% of contractors said Good
11	32	34	34
12	36	12	52

Graph 6: Representation of percentage of Contractors said Poor, Fair and good for the questionnaires



Experienced based or open-ended responses

- All companies reported project cost escalation, primarily due to price increases, indicating a common impact across projects.
- Project funding comes from the private or client side for 47% of contractors, government sectors for 26% of contractors, PPP arrangements for 14% of contractors, and bank loans for 13% of contractors.
- The Design–Build method is adopted by 58% of contractors as the procurement approach, EPC by 34% of contractors, and Turnkey procurement by 8% of contractors.
- Unit rate contracts are preferred by 47% of contractors, lump sum contracts by 34% of contractors, and cost-plus contracts by 19% of contractors.
- Late payments are reported by 44% of contractors as main client-side causes of project delays, design changes by 31% of contractors, and scope variations by 25% of contractors.
- Resource shortages are reported by 36% of contractors as major contractor-side causes of delays, poor quality leading to rework by 28% of contractors, poor planning by 19% of contractors, and rework due to unskilled labor by 17% of contractors.
- Delayed approvals are reported by 52% of contractors as consultant-related causes of delays, design errors by 31% of contractors, and miscommunication by 17% of contractors.
- Schedule tracking is used by 60% of contractors, progress reports by 31% of contractors, and site inspections by 22% of contractors to identify project delays.

- As-Built method is used by 38% of contractors for delay analysis, Time Impact Analysis by 16% of contractors, and Earned Value Analysis by 16% of contractors.
- Project schedules are updated weekly by 40% of contractors, monthly by 32% of contractors, for quality-related purposes by 24% of contractors, and based on project milestones by 4% of contractors.
- Delay analysis tools: 30% of contractors use Primavera P6, 22% use MS Project, and 18% use Excel.
- For delay analysis, 87% of contractors use reliable baseline schedules, while 10% consider the baseline schedules poor, and 3% are not sure about their accuracy.
- For float ownership (total or free float), 50% of contractors determine ownership through survey and analysis, 12% use estimation methods, 18% rely on assessments, 8% use valuation, and 3% use appraisal.
- Regarding responsibility for performing delay analysis, 34% of contractors reported that they themselves are responsible, 32% said the client is responsible, and 4% indicated that it is handled by an independent third party.
- Regarding compensable delays, 47% of contractors indicated that 20% of delays are compensable, 29% said 40% of delays are compensable, 16% reported 60% of delays are compensable, and 8% agreed that 80% of delays are compensable.
- For non-compensable delays (Extension of Time only), 40% of contractors reported that 20% of delays are non-compensable, 16% said 40% of delays are non-compensable, 26% indicated 60% of delays are non-compensable, and 13% and 5% agreed that 80% of delays are non-compensable.
- In analyzing concurrent delays, 37% of contractors handle them critically, 29% systematically, 18% thoroughly, 10% objectively, and 6% quantitatively.
- Delays affect overall project cost in different ways: 37% of contractors indicated that costs are impacted critically, 29% said systematically, 18% reported thorough impacts, 10% noted objective impacts, and 6% considered the impact qualitatively.
- Most contractors recognize that delays affect project costs, with 75% agreeing that delays will impact the overall cost, 13% indicating a higher rate of cost impact, and 12% noting that delays will affect costs for specific dates.
- In terms of total cost increase due to delays, 37% of contractors reported a 5% increase, 45% indicated a 15% increase, 16% observed a 30% increase, and 2% noted a 5% increase in total cost.
- 26% of contractors reported that delayed payments impact cash flow, 37% indicated that revenue is affected, 11% noted an increase in default ratings, 24% experienced financial strain, and 2% reported that disputed schedules influence cash flow.
- For claims related to Extension of Time (EOT), 50% of contractors reported claiming less than 20% of the project cost, 32% claimed 40% of the project cost, and 18% claimed 60% of the project cost.
- 47% of contractors follow the contract terms, 21% apply them on a daily, weekly, or monthly basis, 18% calculate them as a percentage of the total contract value, 10% use a fixed amount per day, week, or month, and 4% cap the penalties at a certain limit.
- 37% of contractors reported that clients respond within a week, 21% said it takes one to two weeks, 29% indicated a response time of two to four weeks, and 13% noted that the response time varies.

- 40% of contractors reported that delays reduce profit margins by 5%, 32% indicated a 10% reduction, 13% noted a 20% reduction, and 16% stated that delays reduce profit margins by more than 25%.
- 47% of contractors stated that risk assessments are conducted for all projects, 37% said they are carried out only for high-value projects, 11% reported that risk assessments are conducted occasionally, and 5% indicated that they never conduct risk assessments.
- To minimize the delay regular progress monitoring will help, 24% of the contractors said comprehensive risk management will help, 9% of the contractors said detailed project planning will help, and 10% of the contractors said contagious planning will help.
- 50% contractors indicated that current project monitoring and reporting systems help control delays, 21% said implementing such systems would be effective, 6% were not sure about their effectiveness, and 13% stated that these systems would not impact delay control.
- From previous delayed projects, 58% of contractors reported learning the importance of better planning and risk management, 29% emphasized improved communication and collaboration, 8% highlighted the need for realistic timelines and resource allocation, and 5% noted enhanced monitoring and control.
- To minimize delays and financial losses in future projects, 61% of contractors recommended robust planning and risk management, 27% suggested effective communication and collaboration, and 13% emphasized regular monitoring and proactive control.

Recommendations

- Clients should avoid late payments.
- Design changes after starting the projects and variation in the scope should be avoided by both clients and contractors.
- Proper planning for all types of resources (Man-power, Materials, Money, Machines and Minutes) should be done well in advance by identifying the sources of availability of resources.
- Approvals should be done as soon as possible/at the earliest.
- Monitoring and tracking of day-to-day progress should be made compulsory.
- Delay analysis should be done on weekly basis to avoid accumulation of prolonged delays.
- Disputes in the compensation of the delays should be avoided.
- Extension of time should be compensated, so that contractors can complete the project work at the earliest.
- Risk assessment should be conducted which well reduce the delay and increase in the cost.
- An effective communication system should be established between all the stakeholders which reduces the delay and uncertainties.

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